Early rehabilitation of abdominal muscle wall following lower transverse abdominal incision in women: a randomized clinical trial

Rehabilitación temprana de la pared muscular abdominal tras una incisión abdominal transversal inferior en mujeres: un ensayo clínico aleatorizado

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Abstract

Introduction: historically, the gynaecologist- obstetrician has favoured lower abdominal transverse incisions. For the abdominal muscle, there is a relevant surgical-related muscle loss induced by major surgical trauma after lower transverse incisions as well as fatigue and restricted respiratory movements during the early postoperative days.
Objective: this study aimed to assess the impact of inducing rehabilitation program for abdominal muscles very early after lower abdominal transverse incisions.
Methodology: a prospective randomized clinical trial that compared 2 groups of 60 participants was conducted. All participants were postoperative women after their 1st cesarean delivery, hysterectomy, and myomectomy. Group A included participants who joined an early specific exercise rehabilitation program for abdominal muscles and postoperative advice. Group B included control volunteers who received the same postoperative care at the hospital and at home as group A.
Results: between-groups comparisons revealed a statistically significant increase in rectus abdominis muscle thickness in favor of group A participants. Additionally, postoperative incisional pain was significantly lower among group A participants, suggesting a strong negative correlation between muscle thickness and postoperative pain.
Conclusions: in summary, adding early mobilization abdominal exercises for rehabilitation programs was very effective to strengthen abdominal muscles, decrease annoying post operative incisional pain and promote early recovery after lower abdominal surgery in women in resources limited countries.

Keywords

Abdominal muscle; lower transverse incision; rectus abdominis thickness; rehabilitation.

Resumen

Introducción: Históricamente, los ginecólogos-obstetras han favorecido las incisiones transversales abdominales inferiores. En el caso de la musculatura abdominal, existe una pérdida muscular relevante relacionada con la cirugía, inducida por traumatismos quirúrgicos mayores tras incisiones transversales inferiores, así como por fatiga y restricción de los movimientos respiratorios durante los primeros días del postoperatorio.
Objetivo: Este estudio tuvo como objetivo evaluar el impacto de la inducción de un programa de rehabilitación para la musculatura abdominal muy tempranamente tras incisiones transversales abdominales inferiores.
Metodología: Se realizó un ensayo clínico prospectivo aleatorizado que comparó dos grupos de 60 participantes. Todas las participantes eran mujeres postoperadas tras su primera cesárea, histerectomía y miomectomía. El grupo A incluyó a participantes que se unieron a un programa temprano de rehabilitación con ejercicios específicos para la musculatura abdominal y recibieron asesoramiento postoperatorio. El grupo B incluyó a voluntarias de control que recibieron la misma atención postoperatoria en el hospital y en casa que el grupo A.
Resultados: Las comparaciones entre grupos revelaron un aumento estadísticamente significativo del grosor del músculo recto abdominal a favor de las participantes del grupo A. Además, el dolor incisional posoperatorio fue significativamente menor en las participantes del grupo A, lo que sugiere una fuerte correlación negativa entre el grosor muscular y el dolor posoperatorio.
Conclusiones: En resumen, la incorporación de ejercicios abdominales de movilización temprana a los programas de rehabilitación resultó muy eficaz para fortalecer los músculos abdominales, disminuir el molesto dolor incisional posoperatorio y promover la recuperación temprana tras la cirugía abdominal inferior en mujeres de países con recursos limitados.

Palabras clave

Músculo abdominal; incisión transversa inferior; grosor del recto abdominal; rehabilitación.

Introduction

In medicine, "abdominal surgery" refers to any operation that targets the abdominal region to diagnose and cure a patient's current health issue (Sullivan et al., 2016). Open abdomen surgeries, also known as laparotomies, typically involve making a wide incision in the abdomen to access the internal organs. Open Abdominal surgery includes vertical and transverse incisions. The standard length for a lower transverse abdominal incision is 10–14 cm, and it is often done one or two finger widths above the pubic crest, to access the uterus, fallopian tubes, and ovaries, as well as perform most cesarean sections, a lower transverse abdominal incision is sufficient.

Traditionally, the gynaecologist-obstetrician has preferred horizontal cuts in the lower abdomen. The favourable aspects of this technique involve better aesthetic outcomes, less discomfort, and a minimal chance of hernia development (Courtney et al., 2024). However, these incisions have limitations such as limited upper abdominal investigation, more blood loss, and a higher risk of hematoma development compared to central incisions. Nerve damage is more likely to cause paresthesia in the overlaying skin with a transverse incision than with a midline one (Deerenberg et al., 2022).

Major surgical trauma after lower transverse incisions might cause muscle loss in the abdominal area (Finnerty et al., 2013). The first several days after surgery are related to exhaustion and restricted breathing (Soares et al., 2013). For the patient, less postoperative pain and rapid return to normal function, as well as better scar appearance and quality of life, are very important factors. Economically, duration of operation and duration of hospital stay determine cost, with time to return to normal activity determining overall cost to the community (Huang et al., 2017).

Encouraging early mobilization after low transverse abdominal surgery is crucial for optimal healing and recovery of abdominal muscles. Physical therapy recommends activities for surgical patients, including transitioning from bed to chair, sitting erect, exercises either in or out of bed, rising from a chair, and moving about the room (Grass et al., 2018).

Up till now, there is no study searching for the effect of starting rehabilitation programs for abdominal muscles very early, within the first 24 hours after obstetrics and gynaecology surgeries. Therefore, this study aimed to assess the impact of early induction of a rehabilitation program for abdominal muscles very early after lower abdominal transverse incisions.

Method

Study design

The study was conducted between February 2025 and August 2025 under a prospective randomized clinical trial design. It was approved by the ethical board of Beni-Suef University's Faculty of Medicine (FMBSUREC/05012025/Awad). All participants in this study provided informed consent.

Sample size

G*POWER statistical software (version 3.1.9.2; Universitas Kiel, Germany) is used to determine sample size. Each group must have 40 participants in order to achieve a mean VAS difference of 2 points. α=0.05, power=90%, effect size=0.8, and allocation ratio N2/N1=1 was used in the computations.

Participants

After the recruitment period, the study included 80 women who met the eligibility criteria. Twenty ladies declined to participate and were thus excluded. Finally, 60 ladies took part in the study.

All patients were recruited from the Gynecology and Obstetrics Department at Beni-Suef University Hospital in Egypt. The participants were between the ages of 35 and 50, with a BMI of 30 kg/m2. All participants were postoperative women after their 1st cesarean delivery, hysterectomy and myomectomy. Group A (study group) included participants who joined an early specific exercise rehabilitation program for abdominal muscles from the day of surgery up to 6 weeks and received postoperative advice. Group B included control volunteers who received standard post-operative care at the hospital and the same recommendations as group A.

Women with cardiac diseases, chronic mental or physical disorders, multiple caesarean deliveries, medical problems preventing abdominal muscle contraction, or failure to complete an informed consent form were excluded from the study. All data was encoded to ensure confidentiality of the subjects. A study assistant who was not involved utilized a computer-generated randomization sequence to divide individuals into two equal groups. The allocation was kept secret by opening sealed, opaque envelopes one at a time to determine which group someone belonged to.

Outcome Measurement

Rectus Abdominis Muscle Thickness

Ultrasound Imaging, each participant was positioned in a crook-lying position, arms resting beside the body, with 1 pillow placed under the head. To measure Rectus Abdominis Muscle thickness, a two-dimensional ultrasound scan with an upright probe (Toshiba Xario100, 8-12 MHz linear transducer) was placed perpendicular to the surface of the skin, 2-3 cm from the midline and 2-3 cm above the umbilicus. All photos were taken at the same moment the exhale ended. Statistical analyses were based on the average of two resting muscle pictures (Ota et al., 2012).

Postoperative incisional pain

Post operative pain assessment was conducted by using the Present pain intensity scale for all participants. Pain intensity at this scale was scored as follows: no pain=0, mild pain=1, moderate pain =2, severe pain=3, unbearable pain=4. This scale is a reliable outcome measure for pain evaluation (Hartrick et al., 2003). All previous measurements were executed by the same researcher either at baseline as well as after 6 weeks of intervention procedure.

Procedure

Participants received further evaluation for the criteria for inclusion and exclusion, as well as demographic data such as BMI and age. Participants in both groups were advised immediately after arriving at wards. Advice included guidelines about getting out of bed by rolling onto the side without twisting on the stomach, pushing on the arms, and lowering legs out of bed to sit up with a pillow behind the lower back to support it, as well as sitting out on a chair for 30 minutes on the first day after the operation and increasing this time each day. Additionally, participants were encouraged to walk around the ward till achieving independency and safety. Next, advice on sleeping with a pillow underneath knee joints while sleeping in a supine position and a pillow between knee joints while sleeping in a side-lying position. Finally, they were instructed to consume a balanced diet and maintain an optimum posture when lifting objects (Adams et al., 2022).

For group A participants the exercise program was divided into 3 time zones: weeks 1&2 after operation, weeks 3&4 after operation, and finally, weeks 5&6 after operation. The same physiotherapist led exercise classes at the Woman's Health Unit of the Faculty of Physical Therapy Outpatient Clinic at Beni-Suef University, except for the first week after surgery in the hospital's wards. Each session included only 5 participants to ensure careful supervision. The exercise program's characteristics (frequency, intensity, time, and type) were developed using the FITT framework in accordance with the American College of Obstetricians and Gynecologists' (ACOG) recommendations for physical activity in sedentary women. For six weeks, the program was followed at a minimum of three sessions per week, with an average amount of perceived intensity of 30 to 60 minutes each. At weeks 1&2 after the operation, exercise session duration was 30 minutes, composed of correcting posture from crock lying, supine, and sitting and standing positions (each exercise was maintained for 5 s and then the woman relaxed for 10 s and repeated this 10 times); Both diaphragmatic and lateral costal breathing techniques were used in the respiratory training intervention; participants in the structured protocol were required to breathe deeply for 5-second intervals, followed by 10-second relaxation periods. This standardized breathing pattern was repeated five times in a row, with static abdominal contraction from crock lying (each contraction was held for 5 seconds followed by relaxation for 10 seconds, 2 sets of 5 repetitions per session). At 3&4 weeks after the operation, an exercise session was conducted for 45 minutes. Each session included 5 minutes of slow walking on a treadmill as a warm-up, followed by 10 minutes of active walking at a medium speed, followed by 5 minutes of slow walking as a cool-down. Next, deep breathing techniques for relaxation include taking a deep breath for 5 seconds, relaxing for 10 seconds, and repeating 5 times. Posterior pelvic tilting exercise from crock lying and supine lying positions (exercise was maintained for 10 seconds followed by relaxation for 20 seconds, 1 set of 10 repetitions per session for each position), and pelvic floor or Kegel's exercises from crock lying (squeezing the pubovaginalis and puborectalis muscles for 10 seconds each was followed by 20 seconds of relaxation). Perform one set of ten reps for each muscle per session.

At 5&6 weeks after the operation, session duration rose to 1 hour. Initially each session included repeating exercises of the 3rd and 4th weeks as well as progressing core stability training from the creeping position (the abdominal muscles were contracted for 15 seconds, followed by 30 seconds of rest). Two sets of ten repetitions per session and knee-rolling exercises from crock lying were conducted for 2 sets of 5 repetitions for each side while maintaining abdominal muscle contraction for 10 seconds. Participants engaged in home workouts on alternate days and attended supervised training three times a week, with exercise sessions being methodically recorded. Self-reported diaries were used to track adherence and attending at least 15 of the 18 sessions was necessary to complete the intervention.

Data analysis

SPSS version 27 was used for all statistical techniques, whether descriptive or inferential. The Shapiro-Wilk test was used to assess the normality of continuous variables, whereas Levene's test was used to determine variance homogeneity.

The baseline features for continuous variables were displayed as mean ± SD, whereas categorical variables were displayed as frequency. A MANOVA was used to investigate changes in the thickness of the rectus abdominis muscles on the right and left sides. The between-subjects component was group (A vs. B), and the within-subjects factor was time (baseline and after six weeks).

Main effects for time and group, as well as the group and time interaction, were examined. The effect sizes were presented using partial eta squared (η^2). Additionally, corrected mean differences with 95% confidence intervals (CI) were computed. Pain severity was analyzed as an ordinal variable (no, mild, moderate, severe, very severe). Baseline and 6-week group comparisons were conducted using the Chi-square test of independence. Effect size was reported using Cramér's V. For presentation, pain categories were summarized as frequency and percentage in each group at baseline and at 6 weeks. All statistical tests were two-tailed, with a significance threshold set at $p < 0.05$.

Results

Baseline measurements show no significant differences ($p > 0.05$) between the two groups in terms of age and BMI probability values (0.326 and 0.085). Similarly, there is no significant difference when comparing Rectus Abdominis Muscle thickness between groups at baseline ($p > 0.05$). In contrast, after 6 weeks, group A shows a marked increase in thickness of the right and left sides of the rectus abdominis muscle, while group B remains unchanged. (Table 1 &2).

Table 1. Right Rectus Abdominis Muscle Thickness at Baseline and After 6 Weeks in the Rehabilitation and Control Groups

	Group A	Group B	Adjusted mean difference	P-value
Pre Rt RA	5.52±0.63	5.54±0.66	−0.02 (−0.34 to 0.30)	0.921
6 weeks Rt RA	7.92±0.58	5.54±0.64	2.39 (2.05 to 2.73)	<0.001*
Model summary	Time effect F = 121.4, $p < 0.001$, $\eta^2 = 0.68$; Group effect F = 97.5, $p < 0.001$, $\eta^2 = 0.63$; Group×Time interaction F = 121.4, $p < 0.001$, $\eta^2 = 0.68$.			

*P-value is significant

Table 2. Left rectus abdominis muscle thickness at baseline and after 6 weeks in the rehabilitation and control groups

	Group A	Group B	Adjusted Mean Difference	P-value
Pre Lt RA	5.23±0.67	5.33±0.69	−0.10 (−0.42 to 0.22)	0.550
6 weeks Lt RA	7.75±0.62	5.34±0.64	2.41 (2.06 to 2.76)	<0.001*
Model summary	Time effect F = 144.8, $p < 0.001$, $\eta^2 = 0.71$; Group effect F = 75.8, $p < 0.001$, $\eta^2 = 0.57$; Group×Time interaction F = 141.7, $p < 0.001$, $\eta^2 = 0.71$.			

*P-value is significant

With regards to baseline of pain severity between groups, most participants in both groups report severe or very severe pain without any significant difference. Instead, after 6 weeks group A participants show a substantial improvement, with the majority reporting no or only mild pain, while group B participants remain predominantly in moderate to very severe categories; this difference was highly significant (p < 0.001). (Table 3).

Table 3. Pain Severity Distribution at Baseline and After 6 Weeks in Rehabilitation and Control Groups

Pain Level	Group A (%)	Group B (%)	P-value	Group A (%)	Group B (%)	P-value
	Baseline	Baseline		6 weeks	6 weeks	
No pain	0	0		16.7	0	
Mild	10	6.7	p = 0.94 Cramér's V = 0.08, negligible effect.	76.7	0	p < 0.001*; Cramér's V = 0.95 (very strong effect).
Moderate	23.3	20.0		6.7	26.7	
Severe	50	53.3		0	56.7	
Very severe	16.7	20		0	16.7	

*P-value is significant

Table 4 shows the topic aspects of Group A and Group B. The groups did not differ substantially in terms of age or gender (p > 0.05).

Table 4. Participants characteristics.

	Group A	Group B	MD	t- value	p-value
	Mean ± SD	Mean ± SD			
Age (years)	38.13 ± 3.99	38.56 ± 4.73	-0.43	-0.383	0.703
Sex, n (%)					
Females	14 (46.6%)	16 (53.4%)		χ2 = 0.267	0.606
Males	16 (53.4%)	14 (46.6%)			

Standard deviation (SD), mean difference (MD), Chi squared value (χ2), and level of significance (p-value).

Table 4. shows a significant shift in the connection between rectus abdominis muscle thickness and pain before and after treatment. Pre-intervention, both right and left RA thickness show strong negative correlations with pain (p < 0.001); it means that reduced muscle thickness is associated with higher pain. However, post-intervention, these associations disappear (p > 0.05), while very strong negative correlation emerges between post-intervention muscle thickness and post-intervention pain (p < 0.001). (Table 5).

Table 5. Correlation between the muscle thickness and pain pre and post intervention

Spearman's rho		Pre Rt RA	Pre LT RA	Post Rt RA	Post Lt RA
Pre pain	r	-0.804**	-0.795**	-0.079	-0.124
	P-value	<0.001	<0.001	0.549	0.346
Post pain	r	0.004	0.031	-0.909**	-0.921**
	P-value	0.974	0.817	<0.001	<0.001

Discussion

Initially, baseline assessments show no significant differences in demographics or Rectus Abdominis between the two groups with regards to muscle thickness, and postoperative discomfort. However, after six weeks of very early rehabilitation to abdominal muscles, group A is significantly improved in Rectus Abdominis muscle thickness as well as sensation of postoperative pain. Additionally, a very strong negative correlation emerges between Rectus Abdominis muscle thickness and level of postoperative pain.

This study's findings align with those of Piccioni, Kassin, et al. who recommend early mobilization out of bed on the 1st postoperative day or even the same day after abdominal surgeries to minimize postoperative complications (Piccioni et al., 2023; Kassin et al., 2012). The definition of early mobilization or early rehabilitation after abdominal surgery includes performing upright activities ranging from sitting over the edge of the bed to structured and planned exercise programs with walking away from the bedside (Castelino et al., 2016) . Furthermore, many trials confirm the safety of early physiotherapy exercise programs as 1 to 6 hours after elective and emergency abdominal surgery (Silva et al., 2013; Kokotovic et al., 2021).

This experiment's results align with those of Adams and Pezeshk et al. who support the safety and effectiveness of early postoperative abdominal exercises to increase the strength, flexibility, and mass of abdominal muscles after abdominal surgeries (Adams et al., 2022; Pezeshk et al., 2015) . Core muscle exercises can improve trunk stability and strength during the immediate postoperative period, according to research (Loor et al., 2021). Abdominal activities following surgery can increase fibroblast infiltration and deposit of collagen, promoting repair of the abdominal fascia (Culbertson et al., 2011). Research suggests that progressive exercise programs can alleviate pain by lowering anxiety and diverting attention (Roykulcharoen & Good, 2014). Exercise may alter the transmission of pain impulses from peripheral nerves to the brain, leading to reduced or no pain perception (Özveren, 2011). Also, those findings support a strong relation between increasing abdominal muscle mass and decreasing postoperative incisional pain.

On the other hand, the present study results are not supported by those of Delphi et al., who find that restricting postoperative activity by minimizing core muscle activity can prevent fascial strain and promote healing of muscles. One of Delphi recommendations is to avoid unnecessary muscle strain by stopping abdominal exercises up to 4 weeks after opening abdominal surgery (van Vliet et al., 2016).

Conclusions

In summary, adding early mobilization abdominal exercises for rehabilitation programs is very effective to strengthen abdominal muscles, decreasing annoying postoperative incisional pain and promoting early recovery after lower abdominal surgery in women in resource-limited countries.

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Conflicts of interest

No competing interests were declared by the authors.

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